

Having thus described the invention, what is claimed as new and secured by Letters Patent is:

### Claims

1. A method of increasing the carbon dioxide-capture capacity of an alkaline earth metal sorbent in the fluidized bed oxidation of combustion fuels comprising:
  - (a) introducing a suitable calcinable material into a fluidized bed;
  - (b) calcining the calcinable material to form an alkaline earth metal oxide and carbon dioxide;
  - (c) carbonating the alkaline earth metal oxide in a carbonator in the presence of concentrated carbon dioxide at elevated temperature such that the alkaline earth metal oxide captures the carbon dioxide to produce an alkaline earth metal carbonate;
  - (d) re-introducing the carbonated alkaline earth metal carbonate into the fluidized bed; and
  - (e) calcining the carbonated alkaline earth metal carbonate to regenerate the alkaline earth metal oxide; and
  - (f) repeating steps (a) to (e) utilizing the product of step (e).
2. The method as defined in claim 1 wherein the carbon dioxide produced in step (b) is pure carbon dioxide.
3. The method as defined in claim 1 wherein spent sorbent and uncaptured carbon dioxide is recovered in step (c).
4. The method as defined in claims 1 wherein the alkaline earth metal carbonate is limestone.
5. The method as defined in claim 1 wherein the alkaline earth metal oxide is lime.

6. The method as defined in claim 1 wherein the fluidized bed for combustion comprises a pressurized fluidized bed combustor (PFBC/C).
7. The method as defined in claim 1 wherein the fluidized bed for combustion comprises a circulating fluidized bed combustor (CFBC/C).
8. A method of increasing the carbon dioxide-capture capacity of an alkaline earth metal sorbent in the fluidized bed oxidation of combustion fuels comprising:
  - (a) introducing a suitable calcinable material into a fluidized bed
  - (b) calcining the calcinable material in a first calciner to form an alkaline earth metal oxide and carbon dioxide;
  - (c) pretreating the alkaline earth metal oxide in a hydration reactor at a suitable temperature and pressure to form an alkaline earth metal hydroxide;
  - (d) carbonating the alkaline earth metal hydroxide to produce an alkaline earth metal carbonate and water;
  - (e) calcining the alkaline earth metal carbonate in a second calciner to regenerate the alkaline earth metal oxide and produce carbon dioxide;
  - (f) carbonating the alkaline earth metal oxide in a carbonator in the presence of concentrated carbon dioxide at elevated temperature such that the alkaline earth metal oxide captures the carbon dioxide to produce an alkaline earth metal carbonate;
  - (g) re-introducing the carbonated alkaline earth metal carbonate into the fluid bed; and
  - (h) calcining the carbonated alkaline earth metal carbonate to regenerate the alkaline earth metal oxide; and
  - (i) repeating steps (c) to (h) utilizing the product of step (h).
9. The method as defined in claim 8 wherein spent sorbent and uncaptured carbon dioxide is recovered in step (f).
10. The method as defined in claim 8 wherein the carbon dioxide produced

in steps (b) and (e) is pure carbon dioxide.

11. The method as defined in claims 8 wherein hydration of the alkaline earth oxide particles is performed using liquid water or steam at a temperature greater than 50°C.
12. The method as defined in claim 8 wherein calcination of the alkaline earth metal carbonate is performed at a temperature in the range of 700°C to 1200°C.
13. The method as defined in claim 11 wherein hydration of the alkaline earth metal oxide particles is performed at atmospheric pressure.
14. The method as defined in claim 11 wherein hydration of the alkaline earth metal oxide particles is performed at a pressure greater than atmospheric pressure.
15. The method as defined in claim 8 wherein the alkaline earth metal carbonate is limestone.
16. The method as defined in claim 8 wherein the alkaline earth metal oxide is lime.
17. The method as defined in claim 8 wherein the fluidized bed for combustion comprises a pressurized fluidized bed combustor (PFBC/C).
18. The method as defined in claim 8 wherein the fluidized bed for combustion comprises a circulating fluidized bed combustor (CFBC/C)..